

(1) An hypertrophy of the thyroid gland of goats can be induced by infecting the water supply with the fæces of sufferers from goitre. It is at present impossible to state whether this hypertrophy is due to the action of the infecting agent of goitre, or only to the organic impurity of the water thus contaminated.

(2) Earthworms do not appear to be concerned in the spread of goitre.

(3) The microscopical appearances described are the earliest stages in the formation of parenchymatous goitre.

The microphotographs (Plate 1\*) illustrate the appearances seen under a magnification of 100 diameters. Fig. 1 shows the normal appearance of the thyroid gland of a goat. Fig. 2 shows the artificially produced parenchymatous goitre.

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### *The Pathogenic Agent in a Case of Human Trypanosomiasis in Nyasaland.*

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[PLATE 2.]

Up to the time of writing, nearly 40 cases of trypanosomiasis have been discovered in Nyasaland, whereas *Glossina palpalis*, notwithstanding much careful searching, has not, as yet, been found in the Protectorate. In view of this fact and also of the observation that the trypanosome derived from a case of Sleeping Sickness contracted in North-East Rhodesia has been shown to present certain peculiarities both morphological\* and also regarding its pathogenicity† in experimental animals, it appeared to us desirable to examine in some detail the parasite derived from a case of human trypanosomiasis infected in Nyasaland. The trypanosome to which this paper refers was obtained from the blood of Mr. R., Case 12 in the Nyasaland Sleeping Sickness Diary.

The following is a short summary of the history of this case:—Patient

\* Stephens and Fantham, "On the Peculiar Morphology of a Trypanosome from a Case of Sleeping Sickness and the Possibility of its being a New Species (*T. rhodesiense*)," 'Roy. Soc. Proc.,' 1910, B, vol. 83, p. 28.

† Yorke, W., "On the Pathogenicity of a Trypanosome from a Case of Sleeping Sickness Contracted in Rhodesia," 'Annals of Tropical Medicine,' 1910, vol. 4.

entered the Protectorate *via* Chinde and Blantyre. Left Blantyre for Angoniland on June 27, 1910. July 1, arrived at Mlanda where he remained four days. July 6, travelled to Mpatso *via* Mpungi, and Dedza, thence to Mt. Dzobwe, 40 miles west, and back. July 19, left Mpatso for Diampwi, where he remained until the 23rd. On the 24th he arrived at Mkoma. July 28, reached Mvera, where he remained for about a fortnight. During his stay here he saw a case of trypanosomiasis. The patient was lying in the open air and Mr. R. did not approach within several yards. August 13, left Mvera on a shooting trip and spent the next day at Maganga's village on the lake shore. On August 15 he went to Patsamjoka, where he remained for two days. August 17, arrived at Nsarula on the Lintipe river. Here he was severely bitten by tsetse (species not recognised). August 18, returned to Mvera. August 19, arrived at Kongwe and complained that the bites in the neck were painful; the next day he felt ill. August 23, neck examined by one of his companions, and a "lump" about the size of a shilling, rather light in colour and surrounded by a dark purple ring, was found in the sub-occipital region, where he had been bitten by fly and where he had experienced pain ever since. During the next few days patient complained of severe headache. Temperature 102·5—104° F. Neck, swollen and painful; face, puffy. August 31, blood examined and trypanosomes found in large numbers.

From the above record of the patient's movements whilst in Nyasaland there appears to be little doubt that he was infected in the Dowa sub-district, possibly in the neighbourhood of the Lintipe River, on August 17.

*Treatment.*—For the first five weeks 6 grains of atoxyl were injected intramuscularly on Thursday and Friday of each week. For a second period of five weeks 3 grains of atoxyl were given every third and fourth day. From the 11th to the 18th week soamin (10 grains) was administered on two successive days in every other week, and perchloride of mercury once in the intervening weeks. As the injections of mercury were very painful and were not followed by any improvement, they were discontinued and soamin alone administered in 10-grain doses every Thursday and Friday.

At first the patient's condition steadily improved. On September 24 there was a sudden attack of adenitis, involving the posterior cervical glands of both sides. Since, there has been a gradual but progressive anæmia, with loss of strength and weight. A characteristic rash developed on the 78th day, but disappeared after a few days. It has reappeared on five or six occasions since. There have also been several subsequent attacks of adenitis.

*Temperature.*—Marked periodicity has been a characteristic feature throughout, the temperature rising to 103° to 105° F., and falling again to

normal at fairly regular intervals. Although no careful enumeration of trypanosomes was made, yet their numbers were noticed "to exhibit a periodicity corresponding to the temperature curve, rises in temperature being associated with increase in the number of trypanosomes in the peripheral blood.

*Morphological Features of the Parasite in the Blood of the Patient.*—Unfortunately, the material at our disposal was rather limited, consisting of a slide of the blood made on August 31, the day on which the disease was first diagnosed, a couple of slides made on November 21, and one on January 4, when the patient passed through Zomba on his way to Chinde. The slide made on August 31 contained numerous trypanosomes, and was sent to the Sleeping Sickness Bureau and examined by Sir David Bruce, who found that the parasite did not differ in any way from the Uganda *T. gambiense*.\*

In the specimens prepared on November 20 and January 4, trypanosomes were more scanty and the parasite could not be distinguished from *T. gambiense*. The parasite presented the characteristic dimorphism, slender forms with long free flagella, short stumpy forms without free flagella, and intermediate forms being found.

*The Morphology of the Parasite in Animals Experimentally Infected.*—The parasite was also studied in the blood of several experimental animals. An English rabbit, bred in Nyasaland, was infected with the trypanosome by subcutaneous inoculation with a small quantity of the patient's blood, and, subsequently, sub-inoculations were made into a monkey (*Cercopithecus*) and a goat. The rabbit and monkey both became heavily infected, and exhibited numerous parasites in the peripheral blood, whereas in the goat trypanosomes were only occasionally found in small numbers.

Examination of the parasite in the blood of the rabbit and monkey at once revealed the same morphological peculiarity which was observed by Stephens and Fantham in the trypanosome obtained from a case of Sleeping Sickness contracted in the Luangwa Valley of North-East Rhodesia, *i.e.*, among the stout and stumpy forms, some had the nucleus at the posterior (non-flagellar) end (Plate 2, figs. 5–12 and 14–17). When the parasites were numerous, it was found that these posterior nuclear varieties formed from 1 to 4 per cent. of the total number of trypanosomes present. Posterior nuclear forms were only observed when the blood contained fairly numerous parasites. They measured 17–22  $\mu$  long.

The other parasites found were indistinguishable from *T. gambiense*, and exhibited the usual dimorphism. The cytoplasm of many of the parasites

\* 'Sleeping Sickness Bulletin,' 1910, vol. 2, No. 21, p. 346.

observed in the blood of the monkey was vacuolated in a remarkable manner, sometimes as many as five or six large clear vacuoles were seen in a single trypanosome (figs. 3, 4, 5, 7, and 9). In many of the parasites the cytoplasm contained large, coarse granules. The posterior extremity of many of the parasites—especially those in which the nucleus was situated posteriorly—presented a blunt, “cut away” appearance. Parasites similar to those described by Stephens and Fantham as “snout” forms were likewise observed, but they did not appear to us to be a prominent feature. After finding these posterior nuclear forms in the blood of the rabbit and monkey, we re-examined carefully the slide of the blood of the patient himself, made on August 31, at a time when the parasites were numerous. A prolonged search failed to reveal the presence of any typical posterior nuclear forms, but several dividing forms were seen, in which one of the nuclei was situated close to the blepharoplast (figs. 16 and 17).

*Pathogenicity.*—Unfortunately, absence of laboratory animals prevented the investigation of this point. The three animals (rabbit, monkey, and a goat) inoculated with the strain by one of us (H. S. S.) in Nyasaland were all easily infected.

*Rabbit.*—Inoculated subcutaneously with blood from the patient. The temperature rose on the sixth day to 105° F., and parasites were found in the blood in small numbers. The animal died on the 27th day. During the last six days trypanosomes were present in considerable numbers. The symptoms observed were those usually found in rabbits suffering from trypanosomiasis, viz., anæmia, emaciation, cedema of the face and ears, and purulent discharge from the nose and eyes.

*Monkey.*—Inoculated from the rabbit. Parasites found in the blood on the seventh day. During the next week trypanosomes were present in considerable numbers, but later they were scanty. The animal was still alive on the 36th day, but was very anæmic and emaciated. There was distinct auto-agglutination of the red blood cells.

*Goat.*—Inoculated from the rabbit. Trypanosomes found in the peripheral blood on the 15th day and on frequent occasions, but always in small numbers, until the death of the animal, which occurred on the 28th day. The symptoms noted were anæmia, wasting, and cedematous swelling of face. The rapidity of the course which the disease ran in this animal is worthy of remark and is in accordance with the observations of one of us working with the parasite obtained from a case of trypanosomiasis infected in the Luangwa Valley.\*

*Conclusions.*—As a result of our observations we are of opinion that the

\* Yorke, W., *loc. cit.*

trypanosome in question is not *T. gambiense*. On the other hand this trypanosome resembles very closely *T. rhodesiense*, and is probably identical with it.

The disease was contracted in a district (Dowa sub-district of Angoniland), where *Glossina palpalis* has never been found, but where *Glossina morsitans* is known to exist in large numbers. It appears probable, therefore, that this trypanosome (*T. rhodesiense*) is a distinct species which is capable of transmission by some other agent than *Glossina palpalis*, probably *Glossina morsitans*.

#### EXPLANATION OF PLATE 2.

Drawn with Abbé camera lucida, using 2 mm. apochromatic objective and No. 18 compensating ocular (Zeiss). Magnification 2150 diameters.

Figures drawn from parasites in the blood of the monkey except when otherwise stated.

Figs. 1—4.—Forms with the nucleus median. Figs. 1 and 2 show line connecting blepharoplast with nucleus; in figs. 3 and 4 marked vacuolation of cytoplasm is seen.

Figs. 5—12.—Forms in which the nucleus is seen to become gradually more posterior until it lies on a level with the centrosome (fig. 5 from patient's blood, fig. 8 from rabbit's blood).

Fig. 13.—Division form with nucleus median (from patient's blood).

Figs. 14—17.—Division forms with one or both nuclei posterior (figs. 16 and 17 from patient's blood).





